RoboCup Junior Australia

# Rescue Maze Rules 2022

Last Modified: 7th February 2022

# RoboCup Junior Australia Executive Committee

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|---|---|
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# RoboCup Junior Australia Rescue Technical Committee

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# Code of Conduct

**Spirit**

It is expected that all participants, students and mentors, will respect the aims and ideals of RoboCup Junior as set out in our mission statement. In turn, the volunteers, referees and officials will act within the spirit of the event to ensure the competition is competitive, fair and most importantly fun. “It is not whether you win or lose, but how much you learn that counts.”

**Sharing**

It is the overall desire of RoboCup Junior competitions, that any technological and curricular developments will be shared with other participants after the competition. Any developments including new technology and software examples may be published on the RoboCup Junior website after the event, furthering the mission of RoboCup Junior as an educational initiative. Participants are strongly encouraged to ask questions of their fellow competitors to foster a culture of curiosity and exploration in the fields of science and technology.

**Local Variations**

These rules will be in use for the Australian National Championships for the titled year. State and Regional competitions may implement minor variations with respect to age groups, divisions and judging. These variations will be communicated to the participants through email and/or on their relevant website prior to the state or regional competition.

**Notes/Advice vs. Rules**

This document includes notes/advice to the competitors and mentors, plus rules that are firm. This has been done to remove ambiguity. There is a notation to indicate whether the content of this document is to be read as a note/advice or as a rule. Notes/advice appear in green.

# Table of Contents

# 1 The Challenge

## 1.1 The Scenario

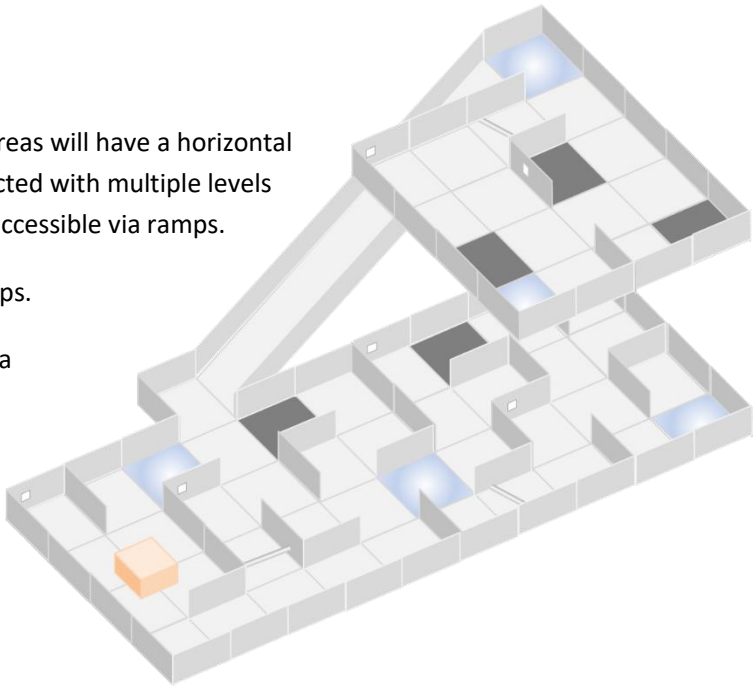
1.1.1 There has been an accident at a manufacturing plant. There are a number of victims still trapped within the plant and it is too hazardous to send in human rescue teams. Your autonomous robot must be able to navigate through a treacherous building with obstacles, uneven floors and restricted areas to identify victims and (optionally) leave rescue packages to aid anyone still trapped. Time and technical skills are essential! Come and prepare to be the most successful Rescue Maze Response Team.

1.1.2 The robot needs to search through a maze for colour identifiable and/or heated victims. i.e. the robot should not find the fastest path through the maze, instead it should explore as much as possible of the maze. The robot will get between 10 to 25 points for each victim found. If the robot can also deliver a Rescue Package (designed by the team themselves) close to the victim it will earn an additional 10 points. The robot should avoid areas with black floor.

1.1.3 If the robot is stuck in the maze it can be restarted at the last visited checkpoint. The checkpoints are indicated with reflective floor so the robot can save its map (if it uses a map) to a non-volatile medium and restore it in case of a restart, optimising the robot's search.

1.1.4 If the robot can find its way back to their starting tile after exploring a large proportion of the maze it will receive an exit bonus.

# 2 Playing Field



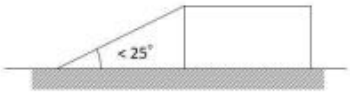
## 2.1 Maze Description

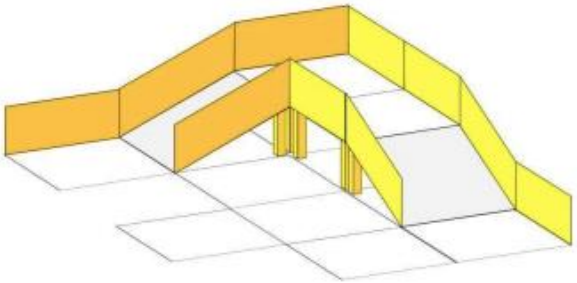
2.1.1 The maze may consist of multiple distinct areas. Areas will have a horizontal floor and a perimeter wall. Mazes may be constructed with multiple levels or floors with a height of 40-60 cm Which will be accessible via ramps.

2.1.2 Areas may be joined together by doorways or ramps.

2.1.3 Walls that make up the maze are at least 15cm to a maximum of 30cm high.

2.1.4 Doorways are at least 30 cm wide (less thickness of walls).



2.1.5 Ramps will be at least 30 cm wide (less thickness of walls) and have an incline with a maximum of 25 degrees from horizontal surface. The ramp is always straight.

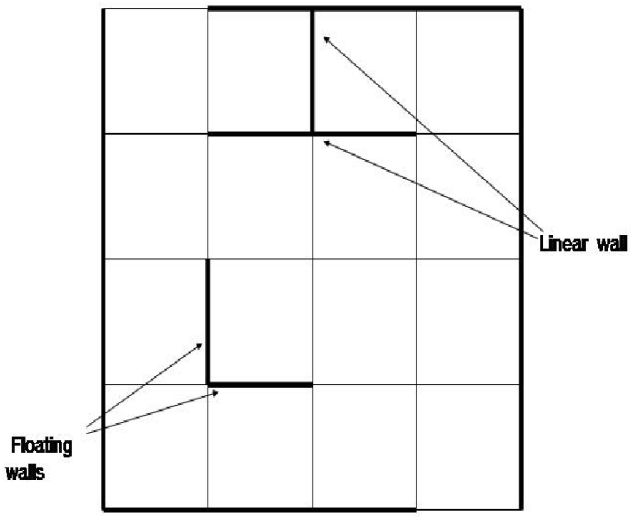
2.1.6 The walls can be any colour

## 2.2 Floor

2.2.1 Floors may be either smooth or textured (like linoleum or carpet) and may have up to 3 mm height difference at joints. There may be holes in the floor (about 5 mm diameter) for fastening walls.

2.2.3 There may also exist silver tiles that represent Checkpoints. Silver tiles may not be completely fixed on the floor.

2.2.4 Throughout the arena, there may exist black tiles that represent “no go” spaces. Black tiles may not be completely fixed on the floor.




## 2.3 Path

2.3.1 Walls may or may not lead to the entrance/exit. Walls that lead to the entrance/exit are called linear walls. The walls that do NOT lead to the entrance/exit are called "Floating Walls".

2.3.2 Paths will be approximately 30 cm wide, but may open into foyers wider than the path.

2.3.3 There may be multiple entries with coloured floors that are randomly selected prior to the start of the run.

2.3.4 Paths may form passages passing under upper floors.

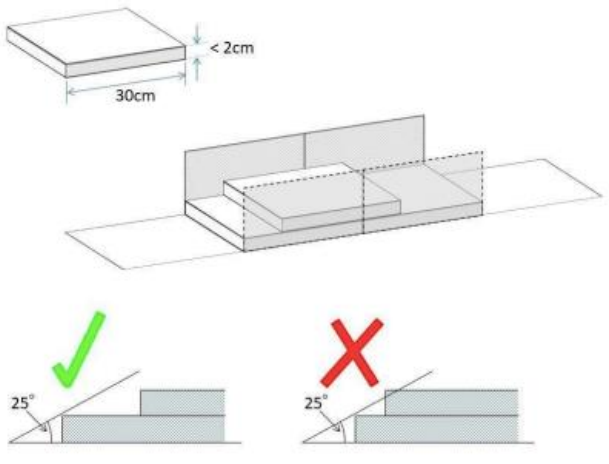
## 2.4 Debris, Obstacles and Stairs

2.4.1 **Floor Obstacles** are fixed to the floor, have a maximum height of 2 cm and will be no closer than 5 cm apart. 2.4.2 **Debris** will not be fixed on the floor, and have a maximum height of 1 cm. Debris can be placed anywhere on the tile.

Hint : Make sure that your robot can negotiate obstacles and has sufficient ground clearance

2.4.3 **Room obstacles** have a minimum height of 15 cm, may consist of any large, heavy items and can be any shape, including rectangular, pyramidal, spherical or cylindrical. Obstacles can be coloured or clear. Obstacles are not fixed to the floor so may be moved by the robot during play.

2.4.4 Obstacles will not prevent a robot from discovering routes in the maze. An Obstacle may be placed in any location where at least 20 cm is left between the obstacle and ~~any~~ a wall.




2.4.5 Floor Obstacles & Room Obstacles that are moved or knocked over will remain where they are moved to/fall and will not be reset during the scoring run.

2.4.6 Stairs will be the full width of the passageway (30cm less thickness of walls) and the individual maximum height is 2 cm.

2.4.7 The incline of stairs (i.e.: the incline of a plate to the horizontal when placed on the stairs) will be less than 25 degrees.

2.4.8 Stairs will be placed between walls

## 2.5 Environmental Conditions

2.5.1 This competition simulates a disaster area. There may be gaps and misalignments between wall panels, differences in flooring materials and heights, and changes may occur as the robot moves through the maze. Teams should expect the environmental conditions at a tournament to be different from the conditions at their home practice field.

2.5.2 Teams must come prepared to adjust their robots to the conditions at the venue.

2.5.3 Lighting and magnetic conditions may vary along the course in the rescue arena.

2.5.4 The arena may be affected by magnetic fields (e.g. generated by under floor wiring and metallic objects).

2.5.5 Teams should prepare their robots to handle unexpected lightning interference. While the organizers and referees will try their best to minimize external lighting interference, it is not possible for them to foresee all unexpected interferences such as camera flash from spectators.

2.5.6 The Organizing Committee will try their best to fasten the walls onto the field floor so that the impact from regular robot's contact should not affect the robot. All measurements in the rules have a tolerance of 5%.

2.5.7 Objects to be detected by the robot will be distinguishable from the environment by their colour and/or heat signature.

# 3 Victims

## 3.1 Definition

3.1.1 Victims are coloured and/or heated sources located on walls, near the floor of the arena (centred approximately 7 cm above the floor).

3.1.2 Each victim has a surface area of at least 15 sq. cm.

3.1.3 Victims are identified by colour pads on walls with a surface area of at least 15 sq. cm.

3.1.4 The organisers will keep a minimum of 10° Celsius difference between victim temperatures and the indoor temperature. The temperature of the victim simulates human body temperature between 28°C to 40°C.

3.1.5 Coloured Victims will be a colour that is easily distinguishable by common light, colour and vision sensors.

3.1.6 In addition to the above up to half the victims will have “locator beacons” simulated by reflective tape (eg. Aluminium tape) fixed to them. The tape will be centred between 12 and 15 cm from the floor and be approximately 5 cm square.

Advice: It is recommended that teams using Lego EV3 robots and software other than the EV3 Classroom Scratch consider using either third party IR temperature sensing or robot vision to identify victims as the standard Lego sensors may not be effective.

## 3.2 Locations

3.2.1 There will be a minimum of five (5) active victims in any round.

3.2.2 Victims can be located anywhere within the maze with the exception of black tiles or on tiles with obstacles. Victims may be located on ramps and stairs.

# 4 Robot

## 4.1 Construction

4.1.1 The height of a robot must not exceed 30 cm.

Advice : Care should be taken in robot design tro ensure that it is of a manageable size to negotiatie its way successfully through the maze and past obstacles

4.1.2 Robots may not have any sensor or devices that enable it to 'see' over the walls.

4.1.3 Any robot kit or building blocks, either available on the market or built from raw hardware and materials, may be used, as long as the design and construction are primarily and substantially the original work of the students.

4.1.4 Any commercially produced robot kits or sensors components that are specifically marketed to complete any single major task of RoboCupJunior Australia Rescue Maze will be disqualified. If there is any doubt, teams should consult the Technical Committee (TC).

4.1.5 For the safety of participants and spectators, only lasers of class 1 and 2 are allowed. This will be checked during inspection.

4.1.6 Robots must be autonomous in operation. If the robot has the capability for remote or other forms of remote control either by Bluetooth, Wi-Fi or some other form of wireless communication, the team must prove that they have disabled the capability for third party operation in some way. This could be by software, hardware or degree of human interaction. Robots that do not comply may face immediate disqualification from the tournament. Distributed control is allowed but must operate without human interaction after the robot has started the round.

## 4.2 Rescue Kits

4.2.1 A Rescue Kit represents a basic health package distributed to a victim caught in a natural disaster. It symbolizes tools or devices used in the rescue process, such as GPS Transponders or even something as simple as food, water or light source providers.

4.2.2 Each Rescue Kit must have a minimum volume of 0.5 cubic cm.

4.2.3 Each team can only carry a maximum number of 12 of those kits.

4.2.4 Each team is responsible for the whole Rescue Kit system (the maximum of 12 kits), including bringing the rescue kits to the competition. The Robot Handler is responsible for loading their own Rescue Kits on their robots and cleaning the field with the referee's/judges' authorization after the game is called to end.

# 5 Inspection

## 5.1 Electronic Submission

5.1.1 Two (2) weeks prior to the competition, each team must electronically submit their journal and program or source code to the competition organisers via the competition web site.

## 5.2 Interviews

5.2.1 Teams may be required to attend a technical interview to explain the operation of their robot in order to verify that the design, construction and programming of the robot is the students' work. There are no set questions. If interviews are being conducted, either a schedule will be released, or teams will be advised to go for an interview throughout the competition prior to the finals.

5.2.2 Teams must bring their journals, logbooks or design diaries and a running laptop to their interview with their program open and be able to talk through the logic of the program with the interviewer. Screenshots of the program are unacceptable.

5.2.3 Interviews are not scored and do not contribute to team overall score.

5.2.4 Team member(s) will be asked questions about their preparation efforts, and they may be requested to answer surveys and participate in videotaped interviews for research purposes.

## 5.3 Journal/Log Book

5.3.1 For the RCJA National Event all teams must maintain a journal or design diary detailing the design, development and construction of the robot and its programs as part of the learning experience. The journal can be in the form of a written document, PowerPoint presentation, website or blog, etc. Journals are not scored and do not contribute to the team's overall score but will be used to determine ownership of designs. Journals may be used to determine the awarding of special honours. State and regional competitions may elect to use other methods to determine originality of students work.

5.3.2 Construction of components (not freely or commercially available to all competitors) must be accompanied by full documentary proof that the developments were wholly the work of the students. This should be in the form of technical documentation showing all stages of design, development, testing and construction.

5.3.3 Failure to produce documentary proof of students' work may result in the robot or bespoke component not being allowed to compete in the tournament.

5.3.4 Teams who fail to submit a journal may not be eligible for trophies or special awards.

## 5.4 Journal/Log Book Criteria

5.4.1 The following headings are a guide in the development of student journals. Note: these criteria are mapped to the Australian National Technologies Curriculum

| | |
|---|---|
| **Team Name** | |
| **Team Members** | List each member's role |
| **School or Organisation** | |
| **Problem Definition** | Define and decompose the problem |
| **Planning** | Identify a number of possible solutions to meet the requirements and constraints |
| | Identify the roles of the team and the order of tasks |
| **Solution Design** | Design the user experience of a digital system |
| | Design Algorithms and validate them. |
| **Implementation** | Implement modular programs, applying selected algorithms and data structures |
| **Evaluation** | Critically evaluate the developed solution. |
| **Student Collaboration** | Create innovative solutions for sharing your ideas and information. |
| | Plan and manage projects using an interactive and collaborative approach |
| **Robot** | Construction Photos |
| | Code |

# 6 Teams

## 6.1 Definition

6.1.1 A team should have a minimum of 2 members and a maximum of 5 members.

**Note**: An individual participant is allowed to compete in a RoboCup Junior Australia National Rescue Challenge as an individual only once. To do so the individual must seek approval from the Challenge Committee. If a team can only afford, or due to extenuating circumstances, cannot send more than one member to a competition, then this is allowed as the Journal / Log book will show that they have been part of a team.

6.1.2 RoboCup Junior Australia Rescue Maze is an Open Challenge: Open to all students studying at a recognised secondary or primary study provider.

6.1.3 In each round one team member is nominated as the Robot Handler. Only the robot handler is permitted to enter the game zone and handle the robot during the round. All other team members must remain outside the game zone unless authorised by the Referee.

6.1.4 The Robot Handler is the only team member permitted to communicate directly with the referees and officials.

# 7 Game Play

## 7.1 Pre-round Practice

7.1.1 Where possible, competitors will have access to practice arenas for calibration, testing and tuning throughout the competition.

7.1.2 Whenever there are dedicated independent arenas for competition and practice, it is at the organizers' discretion if testing is allowed on the competition arena.

## 7.2 Humans

7.2.1 Teams should designate one of its own team members as Robot Handler. Only this team member will be allowed access to the practice/competition arenas, unless otherwise directed by a referee. Only the robot handler will be allowed to interact with the robot during a scoring run.

7.2.2 The robot handler can move the robot only when s/he is told to do so by the referee.

7.2.3 Other team members (and any spectators) within the vicinity of the rescue arena have to stand at least 150 cm away from the arena while their robot is active, unless otherwise directed by the referee.

7.2.4 No one is allowed to touch the arenas intentionally during a scoring run.

## 7.3 Start of Play

7.3.1 A run begins at the scheduled starting time whether or not the team is present/ready. Start times will be posted prominently around the venue.

7.3.2 Once the scoring run has begun, the playing robot is not permitted to be taken from the competition area for any reason.

7.3.3 Each run lasts a maximum of 240 seconds and includes time for calibration.

7.3.4 Calibration is defined as the taking of sensor readings and modifying a robot's program to accommodate such sensor readings. Once the clock has started, a team may calibrate their robot at as many locations as desired on the arena, but the clock will continue to count down. A robot is not permitted to move using its own power while calibrating.

7.3.5 Calibration time is not for pre-mapping the arena and/or the locations of the victims. Pre-mapping activities will result in immediate robot disqualification for the round.

7.3.6 The maze will have a minimum of 2, and up to 4 possible entries. These entries will be a hallway style (that is walls on either side) and will have a floor that is uniformly coloured with the exception of a black strip of 50mm width at the open end. The floors can be red, green, blue or yellow. Calibration for the colour of the entry tile will be included within the Run Time. Entries may be on either the ground or upper levels.

7.3.7 The starting tile for each run will be randomly determined just prior to the commencement of the timed period. Black tiles and Checkpoints may also be relocated at this time.

7.3.8 Once a scoring run has begun, no more calibration is permitted (this includes changing of code/code selection) without penalty as per section 7.5.3.

## 7.4 Scoring Run

7.4.1 Modifying a robot during a run is prohibited, which includes remounting parts that have fallen off.

7.4.2 All parts that the robot is losing intentionally or unintentionally will be left in the arena until the run is over. Neither the team nor the judge are allowed to remove parts from the arena during a run.

7.4.3 A "visited tile" means that more than half of the robot is inside the tile when looking down from above and shall be determined by the referee.

7.4.4 The scoring run ends when:

7.4.4.1 The time expires.

7.4.4.2 The Robot Handler declares an end of their scoring run. The team will be awarded all points achieved up to the call for end of round.

7.4.4.3 The robot returns to the start tile and gets the exit bonus. To collect points, the robot must stop on the exit tile and indicate in some way that it has completed the round. Robot indication should be distinct from the victim indication as detailed in section 7.6.2. The operator should be prepared to demonstrate the exit indication to the referee if required.

7.4.4.4 A team member touches the arena or their robot without permission from a referee. If a team member is in breach of this rule the referee can declare a Restart where the robot is returned to the Start tile as per 7.5.3.

## 7.5 Lack of Progress

7.5.1 A Lack of Progress occurs when:

7.5.1.1 The Robot Handler can request a Lack of Progress from the referee provided that the robot can genuinely not continue through either a stoppage or recursive (looping) behaviour.

7.5.1.2 A robot fails to retreat from a 'visited' black tile. A robot is deemed to have entered the tile when more than half the robot is within the tile as determined by the referee. For a successful retreat, it needs to back up without turning inside the black tile (it has to move straight backwards inside of a black tile). (See definition of visited tile on rule 7.4.3.) If a robot is deemed to have visited the black tile it must return to the last visited checkpoint (or the start tile if never reached a checkpoint). All points scored to that stage are still valid but obstacles and debris will not be reset.

7.5.1.3 A robot or a team member damages the arena.

7.5.2 If a Lack of Progress occurs the robot must be returned to the last visited checkpoint (or the Start tile if the robot has not reached a checkpoint). The robot can be placed in any direction but must be wholly within the tile. The program can be paused but not reset or changed.

7.5.3 After a Lack of Progress or when Rule 7.4.4.4 is breached, the Robot Handler may declare a **Restart**. The team can reset the power supply (turn the robot off and on), change programs, and the maze will be returned to original condition by the referee.
**Note:** All points earned prior to a call of restart are invalid.
**Note:** The round timer remains running.

## 7.6 Scoring

7.6.1 Successful Victim Identification. Robots are rewarded points for each Successful Victim Identification in the arena:

10 points per "victim" located at a tile adjacent to a linear wall (even diagonally), i.e. all victims at the 6 tiles around a linear wall.

25 points per “victim” at floating walls, i.e. all the victims at the 4 floating wall tiles.

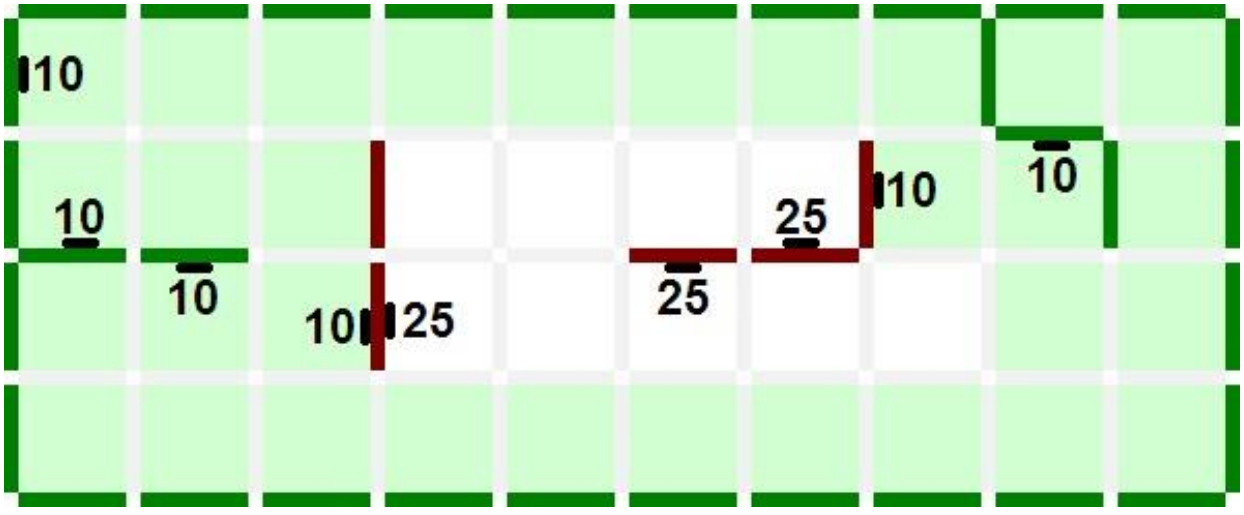
7.6.2 A robot can carry out the following action to successfully identify a victim:

7.6.2.1 Stop for 5 seconds wholly on the same tile as the victim and clearly indicates for the full 5 seconds.

Note: The method used to indicate the discovery of the victim must be clearly observable in the course of play. Audio indicators must be suitable for a noisy competition environment. Visual indicators must be placed in a clearly observable area. These indicators need to be conveyed to the referee before commencing the course.

7.6.3 Scoring Table for Victim Identification:

| State | Indicator | Points Linear Wall | Points Floating Wall | Bonus for One Rescue Kit deployed |
|---|---|---|---|---|
| **Victim Found** | **Clear indication of victim identification** | **10** | **25** | **+10** |




Note: In the above diagram, red/brown lines mean floating walls while the green ones represent linear walls. Some of the victims on the floating walls are worth 10p, because the 10p victims are located in a tile near a linear wall. The colours on the diagram are just for illustrative purposes.

7.6.4 To identify a victim, a robot must stop wholly on the same tile as the victim while using an indication method (see table above).

7.6.5 Successful rescue kit deployment. Robot should drop a rescue kit on the tile where the identified victim is, and the deployment point and the rescue kit needs to be wholly on the tile of the victim. The robot is awarded points (see table) per successful rescue kit deployment.

7.6.6 Successful Checkpoint Negotiation. A robot is awarded 10 points for each visited checkpoint. Refer to 7.4.3 for definition of visited tile.

7.6.7 **Successful Exit Bonus**. A successful exit bonus is awarded when a robot successfully finishes a round on the start tile (see rule 7.4.4.3) and has visited at least 50% of the checkpoints. The points awarded will be 10 points per victim successfully identified.

7.6.8 Ties at the end. Ties in scoring will be resolved on the basis of the time each robot took to complete the run.

7.6.9 No duplicate rewards. For example, if a robot successfully crosses a tile with a checkpoint multiple times, only one successful checkpoint bonus will be rewarded per tile. The same result applies to all other scoring rules.

7.6.9 Table for Checkpoint and Exit Bonus:

| **Action Completed** | **Score** |
|---|---|
| Checkpoint | **10** |
| Exit Bonus | **10 x n (identified victims)** |

# 8 Conflict Resolution

## 8.1 Referee and Referee Assistant

8.1.1 All decisions during game play are made by the referee or the referee assistant who are in charge of the arena, persons and objects surrounding them.

8.1.2 During game play, the decisions made by the referee and/or the referee assistant are final.

8.1.3 At conclusion of game play, the referee will ask the robot handler to sign the score sheet. The robot handler should be given a maximum of 1 minute to review the score sheet and sign it. By signing it, the robot handler accepts the final score on behalf of the entire team; in case of further clarification, the robot handler should write their comments in the score sheet and sign it.

## 8.2 Rule Clarification

8.2.1 If any rule clarification is needed, contact the RoboCup Junior Australia Rescue Technical Committee.

8.2.2 If necessary even during a tournament, a rule clarification may be made by members of the RoboCup Junior Australia Rescue Technical Committee and Organising Committee.

## 8.3 Special Circumstances

8.3.1 If special circumstances, such as unforeseen problems or capabilities of a robot occur, rules may be modified by the RoboCup Junior Australia Rescue Organizing Committee Chair in conjunction with available Technical Committee and Organizing Committee members, if necessary, even during a tournament.

8.3.2 If any of the team members/mentors do not show up to the team meetings to discuss the problems and the resulting rule modifications described at 8.3.1, it will be considered as an agreement.

# 9 Code of Conduct

## 9.1 Spirit

9.1.1 It is expected that all participants (students and mentors alike) will respect the aims and ideals of RoboCup Junior as set out in our mission statement.

9.1.2 The volunteers, referees and officials will act within the spirit of the event to ensure the competition is competitive, fair and most importantly fun.

9.1.3 It is not whether you win or lose, but how much you learn that counts!

## 9.2 Fair Play

9.2.1 Robots that cause deliberate or repeated damage to the arena will be disqualified.

9.2.2 Humans that cause deliberate interference with robots or damage to the arena will be disqualified.

9.2.3 It is expected that the aim of all teams is to participate fairly.

## 9.3 Behaviour

9.3.1 Participants should be mindful of other people and their robots when moving around the tournament venue.

9.3.2 Participants are not allowed to enter setup areas of other leagues or other teams, unless explicitly invited to do so by team members.

9.3.3 Teams will be responsible for checking update information (schedules, meetings, announcements, etc.) during the event. Update information will be provided on notice boards in the venue and (if possible) on the local competition website and/or the RoboCup or RoboCup Junior websites.

9.3.4 Participants who misbehave may be asked to leave the building and risk being disqualified from the tournament.

9.3.5 These rules will be enforced at the discretion of the referees, officials, tournament organizers and local law enforcement authorities.

## 9.4 Mentors

9.4.1 Adults (mentors, teachers, parents, chaperons, translators and other adult team members) are not allowed in the student work area.

9.4.2 Sufficient seating will be supplied for mentors to remain in a supervisory capacity close to the student work area.

9.4.3 Mentors are not permitted to repair robots or be involved in programming of their team's robots.

9.4.4 Mentor interference with robots or referee decisions will result in a warning in the first instance. If this recurs, the team will risk being disqualified.

9.4.5 Robots must be mainly students' own work. Any robot that appears to be identical to another robot may be prompted for re-inspection.

## 9.5 Ethics and Integrity

9.5.1 Fraud and misconduct are not condoned. Fraudulent acts may include the following:

9.5.1.1 Mentors working on the software or hardware of students' robot(s) during the competition.

9.5.1.2 "Higher league group" and/or more advanced group of students may provide advice, but should not do the work for "Lower league group". For example, a secondary group helped to fix its peer primary group's work, software or hardware prior to and/or during the competition. This may also risk disqualification for the secondary group. See "Code of Conduct, 9.4.3 & 9.4.5". This applies not just to mentors, but also to higher league (advanced) groups of students as well.

9.5.2 RoboCup Junior Australia reserves the right to revoke an award if fraudulent behaviour can be proven after the award ceremony took place.

9.5.3 If it is clear that a mentor intentionally violates the code of conduct, and repeatedly modifies and works on the students' robot(s) during the competition, the mentor will be banned from future participation in RoboCup Junior competitions.

9.5.4 Teams that violate the code of conduct can be disqualified from the tournament. It is also possible to disqualify only a single team member from further participation in the tournament.

9.5.5 In less severe cases of violations of the code of conduct, a team will be given a warning. In severe or repeated cases of violations of the code of conduct, a team can be disqualified immediately without a warning.

## 9.6 Sharing

9.6.1 The spirit of world RoboCup competitions is that any technological and curricular developments should be shared with other participants after the tournament.

9.6.2 Any developments may be published on the RoboCup Junior website after the event.

9.6.3 Participants are strongly encouraged to ask questions to their fellow competitors to foster a culture of curiosity and exploration in the fields of science and technology.

9.6.4 This furthers the mission of RoboCup Junior as an educational initiative.